Robotic Arm–Assisted Unicompartmental Knee Arthroplasty

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Robots enable the surgeon to provide improved accuracy and reproducibility with the goal of better outcomes. . . . For robotic systems to gain widespread acceptance in surgery, they must first prove their value in clinical application and ease of use as well as provide a favorable cost-to-benefit ratio.

—William L. Bargar[1]

The concept and process of unicompartmental knee arthroplasty (UKA) for arthritis localized to one compartment of the knee are not new, and the role of UKA has been debated since the procedure was first introduced in the 1970s. As the techniques, component designs, and indications have been refined over the past 10 years, however, the value of UKA has been more clearly defined. Enthusiasm for the procedure by a growing segment of the orthopedic community has resulted in increased market penetration. Approximately 10% of patients who undergo arthroplasty for knee arthritis receive UKA, and that percentage may increase to 20% or more as surgical techniques and technologies continue to evolve, expanding the indications for UKA either alone or in conjunction with patellofemoral arthroplasty. Unfortunately, with conventional UKA techniques, it is difficult to achieve accurate implant alignment on a routine basis, and inaccurate alignment can predispose to premature implant failure. Finding an enabling technology that improves basic clinical and radiographic outcomes without increasing the risk for adverse events has been a "holy grail" for UKA.

Robotic arm–assisted technology is a "disruptive technology" that dramatically enhances the technical performance of unicompartmental surgery, optimizes radiographic alignment of components, and improves early recovery. This technology, which challenges standard UKA instrumentation (ie, intramedullary and extramedullary guides, pinned cutting blocks, jigs, and saws), uses burrs of different sizes, reduces inventory, and optimizes application of minimally invasive approaches, which have been difficult with conventional UKA. The algorithms that constitute perioperative care and recovery are being refined as well, making this a clear value-added proposition for patients, their surgeons, and the hospital systems with access to this technology. This novel robotic arm technology is certainly not a "me too" proposition; it enhances the early outcomes and performance of an established procedure and allows the procedure to be performed with a level of accuracy that may be less achievable on a routine basis with conventional instrumentation or even with surgical navigation in the absence of "smart instruments."

The robotic arm technology that is the focus of this supplement of *The American Journal of Orthopedics* is the semiactive, surgeon-interactive Tactile Guidance System (TGS; MAKO Surgical Corp., Fort Lauderdale, FL), which uses preoperative images of the patient's lower extremity to allow accurate preoperative planning, intraoperative navigation, and robotic assistance to prepare bone for implantation of UKA components. As described in these articles, the TGS provides a stereotactic interface that constrains the surgeon's preparation of the femur and the tibia by restricting the tip of the cutting burr to within a predefined resection volume, thus ensuring enhanced precision in bone preparation.

The authors in this supplement describe the indications for UKA and the rationale for adopting robotic arm technology; detail preoperative planning and use of the TGS in the procedure; provide perspective on perioperative care to enhance the patient's recovery and experience; review short-term results; highlight the design features critical to selective modular knee resurfacing; and provide an economic analysis of the introduction and use of this technology. The reader can synthesize this information to determine whether this innovative, novel, "disruptive" technology may be worth pursuing in his or her own practice.

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Reference

1. Bargar WL. Robots in orthopaedic surgery: past, present, and future. *Clin Orthop.* 2007;(463):31-36.

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